REMARKS

Administrative Overview

Claims 56-67 and 69-75 were examined in the Office action of June 15, 2010, and are pending.

Applicants note with appreciation that the Examiner has withdrawn his claim rejections under 35 U.S.C. 103 over U.S. Publication No. 2002/0154132 (**Dumesny**) in view of U.S. Patent 6,131,097 (**Peurach**), and further in view of U.S. Patent No. 6,707,458 (**Leather**) in light of Applicants' arguments addressing the rejections.

The Examiner has issued a new rejection of the independent claims 56 and 70, and associated dependent claims 57, 59, 65-67, 69, and 71-75, under 35 U.S.C. 103 over **Dumesny** in view of U.S. Patent 5,255,352 (**Falk**) and U.S. Patent 6,131,097 (**Peurach**), and of dependent claims 58 and 60-64 further in view of U.S. Patent 6,707,459 (**Leather**).

Upon entry of this paper, claims 56-67 and 69-75 will still be pending.

Interview Summary

The undersigned thanks the Examiner for his time and courtesy during the telephonic interview that took place on September 14, 2010 with the undersigned and Sabine Volkmer Ward. The undersigned notes that the discussion focused on the arguments presented herein. Accordingly, this paper is intended to constitute a proper recordation of the interview in accordance with MPEP § 713.04, and also to provide a full response to the Office Action mailed on June 15, 2010.

The cited art does not teach all of the elements recited in amended independent claims 56 and 70.

Applicants respectfully traverse the rejections of claims 56 and 70 and their dependent claims over the combination of **Dumesny**, **Falk**, and **Peurach**. The references, whether alone or in combination, fail to teach at least the following two elements of Applicants' independent claims 56 and 70:

- defining a NURBS patch over an arbitrarily-shaped user-defined region of a surface of a three-dimensional virtual object, and using the NURBS patch in a texture mapping scheme wherein points of a planar mesh are adjusted to account for a spacing of corresponding points within the NURBS patch; and
- modeling points of the planar mesh as connected by mechanical modeling elements, wherein the points of the planar mesh are adjusted to reduce an energy associated with the modeling elements.

The references also fail to teach the combination of the above two elements.

1. The cited art does not teach representing an arbitrarily-shaped user-defined region of a surface of a virtual object using a NURBS patch and using the NURBS patch for texture mapping in the manner recited in each of independent claims 56 and 70.

Amended independent claims 56 and 70 recite, respectively, steps of and instructions for defining a NURBS patch over an arbitrarily-shaped, user-defined region, and using the NURBS patch in a texture mapping scheme wherein points of a planar mesh are adjusted to account for a spacing of corresponding points within the NURBS patch.

Applicants previously argued in their response filed on April 13, 2010, to the Office Action of February 17, 2010, **Dumesny** does not teach the use of a NURBS patch at all, let alone the use of a NURBS patch in the manner recited by Applicants' claims. In particular, **Dumesny** models the surface of a three-dimensional object with a polygon mesh for purposes of texture mapping. *See, e.g.*, **Dumesny**, paragraphs [0011]-[0015]. This mapping method is fundamentally different from the approach in the instant application. Further, Applicants previously argued that neither **Peurach**, which was cited by the Examiner with regard to another claim element (the modeling of points of the planar mesh as connected by mechanical modeling elements), nor **Leather**, which was cited with regard to various dependent claims, cures this deficiency.

Applicants submit that the newly cited reference, **Falk**, also fails to teach or suggest the use of NURBS patches for texture mapping in the manner recited in claims 56 and 70. While **Falk** mentions NURBS as one of a number of different parametric surface types that could be used to represent a 3D virtual object, there is no use of NURBS in the texture mapping scheme in **Falk**, as recited in the claims of the instant application. The surface of a virtual object in **Falk** is approximated by a polygonal mesh for texture mapping purposes. Thus, **Falk**, like **Dumesny**, describes a polygonal-mesh-based texture mapping approach, which is fundamentally different from Applicants' claimed method. **Falk** explains:

> A 3-D surface that represents part of the overall 3-D object is assumed to have defined over it a 2-D parameterization, meaning that for every distinct point on the entire surface there are unique parameters s and t in the orthogonal coordinate system of the surface defining that point. There are several parametric surface types … Among them are NURBS … surfaces. Any of these would be suitable for use with the present invention. The only real requirement for the surface type used is that it must be possible to compute a mesh consisting of 3-D points lying in the surface. These mesh points would then be the vertices of polygons that, taken all together, approximate the entire surface by discrete facets. …. The more closely the (s,t) grid points are spaced, the more closely a polygonal mesh made from the resulting (x,y,z) vertices will approximate the surface in 3-D space. The polygons resulting from the discretization of the surface are used by the flattening algorithm as detailed in the co-pending Wu application, as well as input to the texture mapping function. As can be inferred here, the only requirement on a surface type is that a polygonal mesh that suitably

> approximates the surface may be generated to serve as input to the flattening and texture mapping processes.

Falk, col. 4, l. 52 through col. 5, l. 18 (emphasis added). **Falk** describes the texture mapping method using polygonal meshes in more detail with respect to FIG. 2

> Referring to FIG. 2, a portion of a 3-D CAD system employing the present invention is illustrated. The steps from surface and image creation through surface flattening, pattern piece placement, and final application of textures using the present invention are outlined.
>
> The process begins with the creation of 3-D surfaces. The surfaces are piecewise parametrically defined surfaces (NURBS …) that may interpolate or approximate a mesh of 3-D (X,Y,Z) points …
>
> Once a parametrically defined surface has been obtained, an approximating 3-D polygonal mesh may be computed 104. The vertices of the polygonal facets making up this mesh lie in the parametric surface …
>
> A 2-D flattened pattern piece mesh may be computed 106 from the 3-D approximating polygonal mesh of a surface using the technique disclosed in assignee's co-pending application to Wu. Every polygon in the 3-D mesh has a 2-D counterpart in the flattened mesh. …
>
> The bitmap image to be used as a texture by the mapping function may be created in a 2-D design/image processing system 100 by several means. … the result is a rectangular array of pixels of which the user may select all or any portion to be used as the bitmap image 100 for texture mapping. …
>
> Once the 2-D flattened pattern piece and the bitmap image have been created, the present invention provides a tool for positioning and orienting the texture on the surface … The portion of the repeats of the bitmap image lying within the outline of a given pattern piece outline is the texture that will be mapped to the 3-D surface corresponding to this pattern piece by the texture mapping software incorporating the present invention.
>
> Once there exists a 3-D mesh 104, a corresponding 2-D mesh 106, a bitmap image of known real-world size 100, and an orientation of the 2-D mesh relative to repeats of the bitmap image …, the user may then use the texture mapping software employing the current invention to accurately map the bitmap image to the 3-D surface while preserving as much as possible the dimensional integrity of the image when mapped 114.

Falk, col. 10, l. 64 through col. 12, l. 15 (emphasis added).

It is apparent from the above excerpts that **Falk** teaches away from mapping a texture onto a NURBS representation of the surface of the three-dimensional object, and instead relies on (i) modeling the surface with a plurality of polygons, and (ii) mapping the texture onto the polygons, as in **Dumesny**. By contrast, Applicants' claimed invention recites (i) defining a NURBS patch over a user-defined region, and (ii) mapping locations in the NURBS patch to corresponding locations in a texture (according to a mapping scheme wherein points of a planar mesh are adjusted to account for a spacing of corresponding points within the NURBS patch, and wherein the texture is superimposed onto a second patch based on the adjusted planar mesh). Therefore, **Falk** fails to cure the failure of **Dumesny**, **Peurach**, and **Leather** to teach the claimed invention.

Applicants previously argued, in their response filed on January 27, 2010, to the Office Action of July 27, 2009, that the use of a NURBS patch for texture mapping lends patentable weight to Applicants' claimed invention. As Applicants have explained, representing an arbitrarily-shaped, user-defined surface region of a three-dimensional object with a NURBS patch for texture mapping purposes is advantageous because it inherently provides more flexibility in modeling the three-dimensional surface. For example, the boundaries of a NURBS patch need not be straight line segments, but may have variable curvature. *See, e.g.,* paragraph [0022] of the specification, as well as FIGS. 3A-3B. Furthermore, the area of a NURBS patch may have variable curvature in three-dimensional space (*see, e.g.*, FIGS. 18A-18B of the specification), whereas a polygonal representation necessarily consists of planar segments. Thus, NURBS patches afford the user greater flexibility in defining the surface region to which a texture will be applied, and facilitate a more robust, smoother fit to the surface region that is being modeled. Moreover, NURBS patches can represent any analytically definable surface exactly. *See, e.g.,* paragraph [0110] of the specification.

Prior texture mapping methods based on polygon mesh representations of the surface are not able to achieve these advantages. For example, **Dumesny**, in which the surface of a three-dimensional object is modeled with a plurality of polygons, relies on predetermined standard mapping functions (e.g., a standard plane mapping function) to map a texture onto the planar segments, and facilitates manipulation (e.g., scaling, rotation) of the texture in user-selected sets of polygons, e.g., to correct for any texture mapping artifacts. *See, e.g.*, **Dumesny**, paragraphs [0011]-[0016]. (*Also see* **Dumesny**, paragraphs [0034] and [0038]-[0041], for a description of artifacts that are typically associated with the application of standard mapping functions to arbitrary, non-primitive surface topologies.) Further, a polygonal mesh will only approximate a curved surface, and the accuracy of the polygonal representation can only be increased by increasing the resolution of the polygonal mesh, thereby increasing the associated computational cost.

Further advantages of the instant invention are described in Applicants' responses filed on January 27, 2010, and on April 13, 2010, which are hereby incorporated herein by reference. Applicants note that the Examiner has found the arguments presented in both responses persuasive. *See* Office Action of June 15, 2010, Response to Arguments on p. 12; Office Action of February 17, 2010, Response to Arguments on p. 11.

In light of the foregoing, Applicants respectfully request that the Examiner withdraw the new rejection of the independent claims over the combination of **Dumesny** and **Falk**.

2. The cited art does not teach a mapping scheme that models points of a planar mesh as connected by mechanical modeling elements and reduces an energy associated therewith, as recited in each of independent claims 56 and 70.

Independent claims 56 and 70 each recite a mapping scheme wherein points of a planar mesh are adjusted to improve a quality metric associated with the spacing of corresponding points in a NURBS patched defined over a user-defined region of a three-dimensional virtual object. A plurality of points of the planar mesh are modeled as connected by mechanical modeling elements, and the points of the planar mesh are adjusted to reduce an energy associated with the mechanical modeling elements. As explained in Applicants' response filed on April 13, 2010, **Peurach** fails to teach or suggest the use of mechanical modeling elements in this manner.

Peurach appears to be directed to system and methods for authoring geometrical databases that define virtual objects in term of not only their visual, but also their haptic and other physical attributes, which may affect the haptic feedback that a user feels when encountering the virtual object in virtual three-dimensional space through his avatar. *See, e.g.*, **Peurach**, col. 2, lines 10-19, and col. 3, line 29 through col. 4, line 16. In **Peurach**, physical attributes and features, such as, e.g., classic spring and damper representations, refer to the actual attributes of the virtual object. *See, e.g.*, Peurach, col. 10, line 58 through col. 11, line 56.

By contrast, the mechanical modeling elements in Applicants' claimed invention do not represent the physical properties of the virtual object. For example, in Applicant's invention, the springs model distances—pure geometric quantities—between points of the first mesh, not any forces associated with the three-dimensional virtual object. *See, e.g.*, paragraph [0118] of the specification (stating that the "distances between neighboring points of the first mesh … can be used as set lengths for corresponding springs"). Further, the "energy" associated with Applicants' modeling elements does not correspond to a physical energy of the virtual object, but constitutes a physically intuitive "quality metric" used for adjusting a texture (e.g., a pattern, color, or other visual attribute) that is to be mapped onto the surface of the virtual object. *See, e.g.*, paragraph [0115] of the specification. Applicants' mapping scheme is described, for example, in paragraphs [0017]-[0018] of the specification:

> Thus, in one aspect, the invention is drawn to a method for mapping a location on a surface of a 3D virtual object to a corresponding location on a 2D texture including the steps of: selecting a region on the surface of the 3D virtual object; creating a first mesh of points corresponding to points within the selected region; creating a second mesh of points corresponding to points of the first mesh; adjusting the second mesh to improve a quality metric associated with an arrangement of points of the second mesh; relating the adjusted second mesh to the 2D texture; and mapping a location in the selected region to a corresponding location in the texture.
>
> In a preferred embodiment, the first mesh varies in three dimensions according to the surface of the object within the selected region, while the second mesh is a planar mesh. The step of adjusting the second mesh in the method above may further include defining the

> quality metric using the first mesh. For example, the quality metric may be a measure of total spring energy, where distances between points of the first mesh are used as set lengths for springs connecting points of the second mesh.

(Emphasis added.) Note that the mechanical modeling elements recited in Applicants' claims connect the points of a second, planar mesh upon which the texture is superimposed, not points on the surface of the three-dimensional object itself. The specification explains further:

> [T]he second mesh is adjusted to improve and/or optimize a quality metric associated with the arrangement of the points of the second mesh. This quality metric is related to the first mesh …, which in turn corresponds to the shape of the surface of the 3D object … within the defined region ... Thus, [adjusting the second mesh to improve the quality metric] allows points on the surface of the 3D object to be mapped into the two-dimensional texture without the need for geometric projection and without the distortion that accompanies projection when the 3D object is not a regular, geometrically-defined shape.

Paragraph [0115] of the specification.

Peurach does not teach such a texture mapping scheme involving mechanical modeling elements (and the reduction of an energy associated with these modeling elements), because **Peurach** is not concerned with texture mapping methods per se.

For at least these reasons, Applicants respectfully submit that **Peurach** fails to teach a mapping scheme that that models points of a planar mesh as connected by mechanical modeling elements, as recited in independent claims 56 and 70. Further, **Dumesny**, **Falk**, and **Leather** do not cure this deficiency. Therefore, none of **Dumesny**, **Falk**, **Peurach**, and **Leather**, nor any combination thereof, discloses or suggests a texture-mapping scheme using mechanical modeling elements as recited in Applicants' claims.

In light of the foregoing, Applicants' respectfully submit that independent claims 56 and 70 and all their dependent claims are patentable over the combination of **Dumesny**, **Falk**, **Peurach**, and Leather on at least two independent grounds, as they fail to teach at least two claim limitations. Accordingly, Applicants request reconsideration and withdrawal of the rejection, and allowance of the claims in due course. Applicants reserve the right to present further arguments regarding the patentability of the dependent claims, should this become necessary.

CONCLUSION

Applicants contend the claims are in condition for allowance. Applicants respectfully request reconsideration and withdrawal of all rejections, and allowance of claims 56-67 and 69-75 in due course. The Examiner is hereby cordially invited to contact Applicants' undersigned representative by telephone at the number listed below to discuss any outstanding issues.

Respectfully submitted,

Date: September 15, 2010
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